FINAL
TASK-SPECIFIC PLAN
RADIOLOGICAL SURVEY OF BUILDING 3 AND IMPACTED WASTEWATER DRAINS
Naval Station Treasure Island
San Francisco, California

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LIST OF ACRONYMS AND ABBREVIATIONS

CDPH	California Department of Public Health
cm	centimeter(s)
cm^2	square centimeter
cm/s	centimeters per second
cpm	counts per minute
CoC	chain of custody
CSO	NSTI Caretaker Site Office
DoD	United States Department of Defense
dpm	disintegrations per minute
DQO	data quality objective
HRA	historical radiological assessment
IDW	investigation-derived waste
ITSI Gilbane	ITSI Gilbane Company
LBGR	lower bound of gray region
LLRW	low-level radioactive waste
m	meter(s)
m^2	square meter(s)
m/s	meters per second
MARSSIM	Multi-Agency Radiation Survey and Site Investigation Manual
MDC	minimum detectable concentration
mg/cm^2	milligram per square centimeter
min	minute(s)
N/A	not applicable
NAD	North America Datum
NaI(Tl)	sodium iodide (thallium-activated)
Navy	United States Department of the Navy
NRC	United States Nuclear Regulatory Commission
NSTI	Naval Station Treasure Island
pCi/g	picocuries per gram
QA	quality assurance
QC	quality control
Ra-226	radium-226
RASO	Naval Sea Systems Command Detachment, Radiological Affairs Support Office
ROC	radionuclide of concern
ROICC	Resident Officer in Charge of Construction
RMP	NSTI Basewide Radiological Management Plan
RPM	Remedial Project Manager
RPP	Radiation Protection Plan
SAP	Sampling and Analysis Plan
Th-232	thorium-232
TriEco-Tt	Tri-Eco and Tetra Tech EMI Joint Venture
TSP	task-specific plan

UBGR	upper bound of gray region
USA	Underground Service Alert
Weston	Weston Solutions, Incorporated
WRS	Wilcoxon Rank Sum
WWII	World War II
ZnS(Ag)	zinc sulfide (silver-activated)

1.0 INTRODUCTION

This task-specific plan (TSP) provides information and details for the radiological survey of Building 3 and impacted wastewater drains at the former Naval Station Treasure Island (NSTI) in San Francisco, California. The impacted wastewater drains include existing gravity-fed wastewater drain piping that extends from Building 3, and from beneath the footprint of the former Buildings 7 and 233, and continues to downstream pumping stations. Survey data will be collected and analyzed to determine if residual radioactivity requiring remediation is present. If remediation is required, the Navy will be consulted. If no remediation is required, the survey data will provide the suitable technical basis to clear the building and wastewater collection system radiologically for unrestricted use.

This TSP was prepared by the ITSI Gilbane Company (ITSI Gilbane) for the United States Department of the Navy (Navy) Base Realignment and Closure Program Management Office West under Radiological Environmental Multiple Award Contract N62473-10-D-0808, Contract Task Order 0006, with the Naval Facilities Engineering Command Southwest, based on the Statement of Work submitted by the Navy on July 12, 2012.

1.1 SITE DESCRIPTION AND SUMMARY

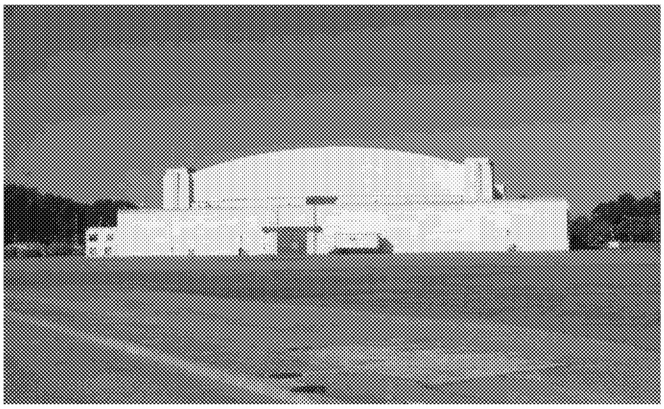
The *Final Treasure Island Naval Station Historical Radiological Assessment, Former Naval Station Treasure Island, California* (HRA; Weston Solutions, Incorporated [Weston], 2006), provides a comprehensive history of radiological operations conducted by the Navy and its contractors at the former NSTI. The *Draft Historical Radiological Assessment – Supplemental Technical Memorandum, Naval Station Treasure Island, San Francisco, California* (Tri-Eco and Tetra Tech EMI Joint Venture [TriEco-Tt], 2012) documents the findings of additional investigation relative to the radiological operations and disposal at the former NSTI. The additional investigation included the research of historical records and the review of reports documenting intrusive investigations performed after the earlier HRA was published in February 2006.

No radiological investigations of Building 3 or of the impacted wastewater drains have been performed.

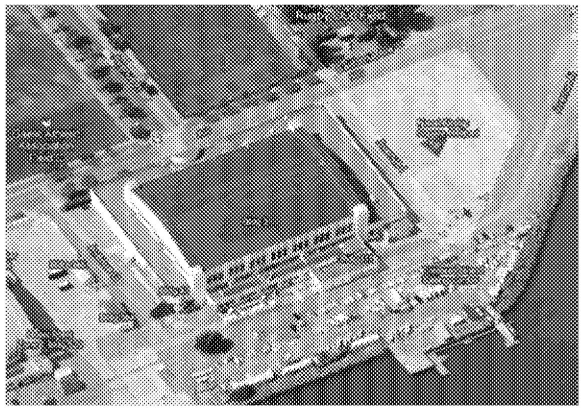
1.1.1 Building 3

Building 3 is located in the southeastern corner of NSTI, as shown on Figure 1 (found at end of document). It is a large hangar surrounded by an attached two-story-high structure on three sides. The building covers approximately 145,000 square feet (13,500 square meters [m^2]), and is one of the original buildings constructed on Treasure Island for the 1939 Golden Gate International Exposition. Figure 2 shows views of Building 3.

Figure 2 - Views of Building 3



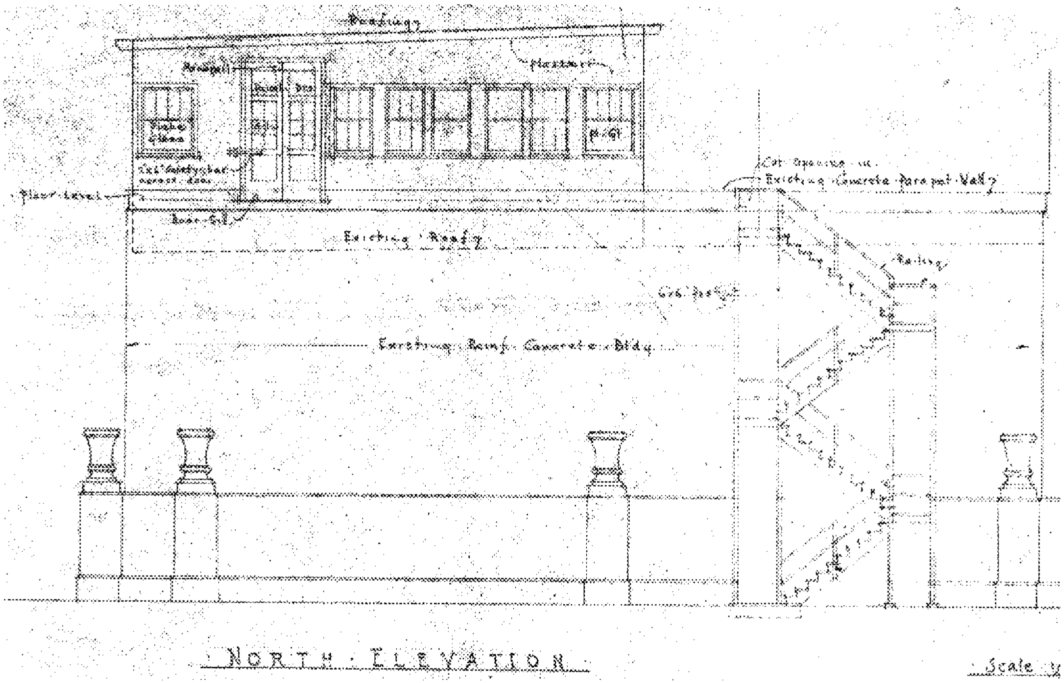
View of East Side (Looking West)



Aerial View From the South

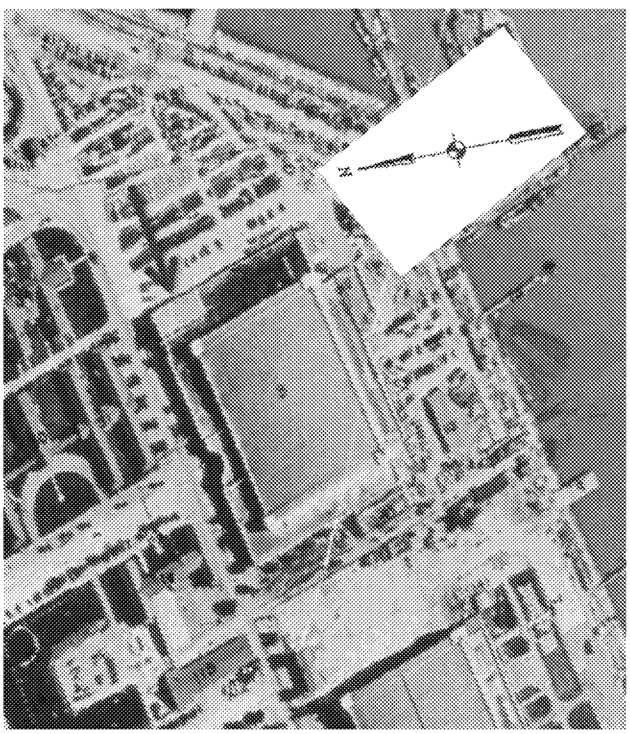
Extensive ship repair activities occurred at the former NSTI during World War II (WWII). Building 3 was configured to conduct significant inside shop work associated with ship repair activities. The building is considered to be radiologically impacted due to the potential for those repair activities to have involved radioactive material, such as radioactive deck markers found on hull plating or radioluminescent gauges associated with ship repair activities. Research also identified the presence of an optical shop (now demolished) in the northeastern corner of the roof (see Figures 3 and 4).

Figure 3 – Elevation View of Optical Shop on Building 3 Roof (Looking South)

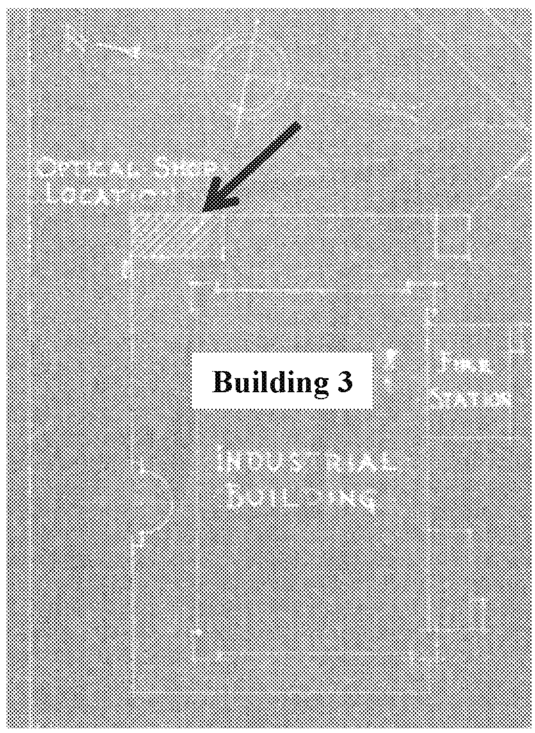


(Source: Treasure Island D.P.W Drawing No. DB-33.486 [Navy, 1944])

Figure 4 – Photo and Drawing Showing Location of Optical Shop on Building 3



(Source: Draft HRA – Supplemental Technical Memorandum [TriEco-Tt, 2012], circa 1945)



(Source: Treasure Island D.P.W Drawing No. DB-33.486 [Navy, 1944])

The optical shop was 91 feet (28 meters [m]) long by 40 feet (12 m) wide, and was built on a platform above the Building 3 roof nearly flush with the top of the concrete parapet walls (see Figure 3). The presence of an optical shop is notable, as these shops on other bases historically have been found to have radium and thorium contamination associated with their operations. Radium and thorium were used for their radioluminescent properties in gauges, deck markers, optical sighting devices, and range-finders during the WWII period.

1.1.2 Impacted Wastewater Drains

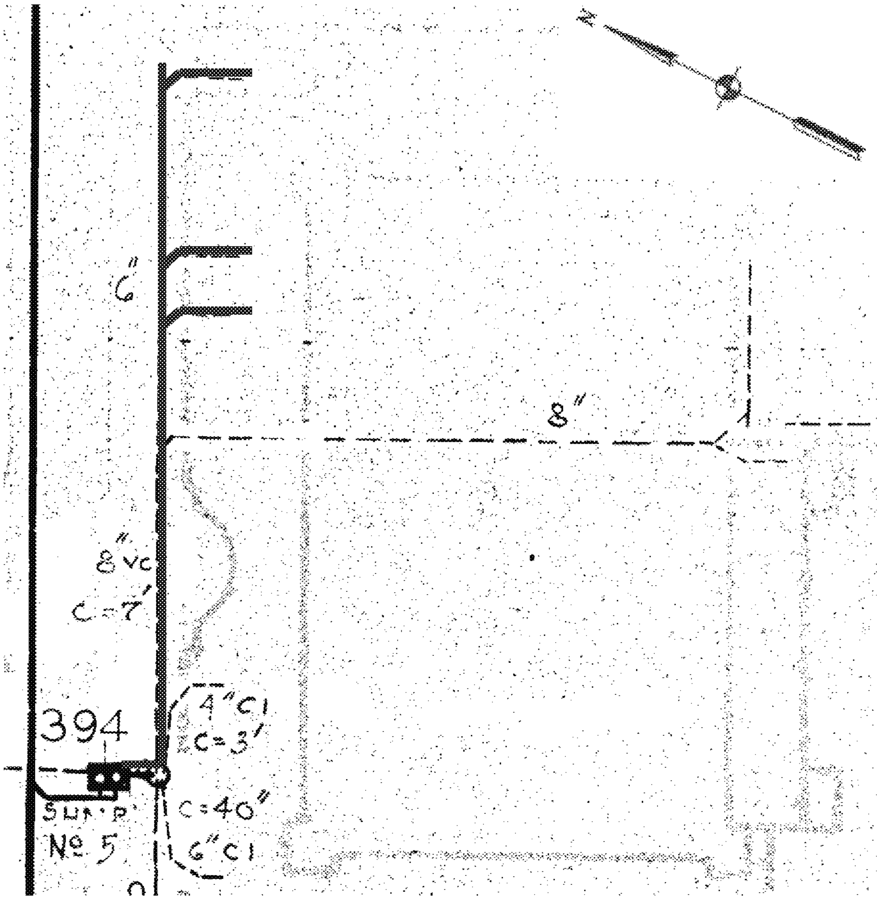
Radioactive material may have been discarded down wastewater drains in buildings where activities involving radioactive materials occurred. The optical shop on the roof of Building 3 was a possible source of contamination. The plan elevation and details show the presence of sinks and drains in the optical shop. The optical shop was demolished in 1969, and part of the drain line serving the shop was removed along with the shop. The remaining drain lines, highlighted on Figure 5, are considered impacted from the point of origin in the shop to the pump station. The 6-inch sanitary sewer line shown on Figure 5 was added sometime after 1943, as it is not shown in earlier drawings and, therefore, may have been added in association with the construction of the optical shop. The system from the Building 3 drains by gravity into Sump No. 5.

Activities involving radioactive materials occurred in the former (now demolished) Buildings 7 and 233. Early on, Building 7 was used for radiation safety training. In 1950, a significant radium spill occurred in Building 233. The wastewater collection systems from the former Buildings 7 and 233 join and drain by gravity to Sump No. 6, as shown in Figure 6.

1.2 SCOPE

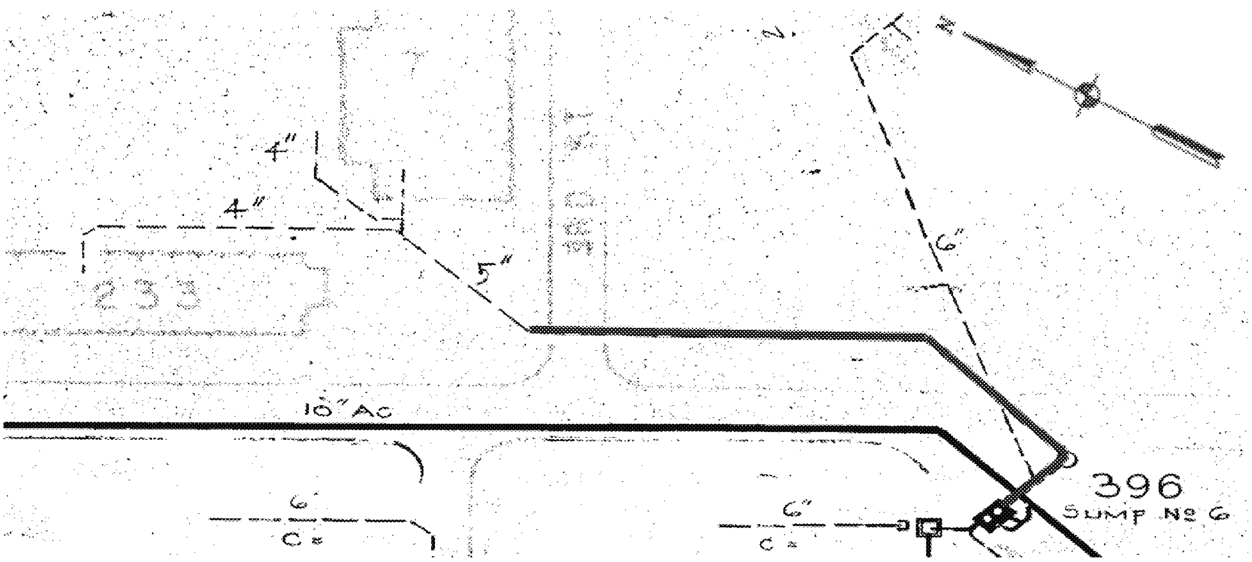
Building 3 was used for ship repair activities during WWII, and these activities may have involved radioactive materials. Therefore, the entire building will require radiological evaluation. A primary area of concern at Building 3 is the northeastern corner of the roof, where the optical shop was located, and the sanitary sewer pipe (drains and standpipe) that drains the roof area. In addition to the building proper, the radiological evaluation will include the ground surface for a 2-m width around the perimeter of the building, with a focus on the roof storm drain outfalls and building entryways.

Figure 5 – Wastewater Collection System Draining, Northeastern Corner of Building 3



(Source: Drawing No. T.I. SE-121; piping within scope denoted in red)

Figure 6 – Wastewater Collection System Draining, Former Buildings 7 and 233



(Source: Drawing No. T.I. SE-121; piping within scope denoted in red)

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The radiological survey will include the portions of the wastewater collection system from buildings in which activities involving radioactive materials occurred. Specifically, this includes the gravity-fed wastewater pipes and manholes that drain the northeastern corner of Building 3 to Sump No. 5 (see Figure 5) and the gravity-fed wastewater pipes and manholes that drained former buildings 7 and 233 to Sump No. 6 (see Figure 6). The upstream piping shown in Figure 6 has been removed. The piping downstream of the sumps, which is outside the survey scope, subsequently is connected to the force main to the treatment plant. A summary of system components within the survey scope, based on a 1972 drawing (Drawing No T.I. SE-121), is provided in Table 1.

Table 1 – Summary of Wastewater Collection System Components

Impacted System/ Pipe Diameter	Wastewater Pipes (Estimated Length)				No. of Manholes	No. of Pump Stations
	5-inch	6-inch	8-inch	Total		
Building 3	--	105 m	45 m	150 m	1	1
Buildings 7 and 233	15 m	105 m	--	120 m	2	1

Source: Drawing No. T.I. SE-121, Treasure Island Sanitary Sewer System, dated August 1972
m - meters

1.3 GUIDING DOCUMENTS

Where not otherwise specified in this TSP, work activities will be accomplished in accordance with the procedures and methodologies detailed in the *Basewide Radiological Management Plan, Naval Station Treasure Island, San Francisco, California* (RMP; ITSI Gilbane, 2013). Supporting documents guiding work activities are appended to the RMP.

1.3.1 Qualty Assurance/Quality Control

Quality assurance (QA) and quality control (QC) activities will be implemented and maintained in accordance with the Contractor Quality Control Plan and the Sampling and Analysis Plan (SAP) provided as Appendices A and B, respectively, to the RMP (ITSI Gilbane, 2013).

1.3.2 Radiation Protection

Radiation protection measures will be implemented and maintained in accordance with the Radiation Protection Plan (RPP) provided in Appendix C to the RMP (ITSI Gilbane, 2013).

1.3.3 Environmental Protection

Environmental protection will be implemented and maintained in accordance with the Waste Management Plan, the Storm Water Pollution Prevention Plan, and the Dust Control Plan provided in Appendices D through F, respectively, to the RMP (ITSI Gilbane, 2013).

1.3.4 Health and Safety

Health and safety measures will be implemented and maintained in accordance with the Health and Safety Plan, which includes an Accident Prevention Plan, Site Safety and Health Plan, and an Activity Hazard Analysis. The Health and Safety Plan is provided in Volume II of the RMP (ITSI Gilbane, 2013).

1.4 RADIOLOGICAL SCREENING CRITERIA

The radiological screening criteria are listed in Table 2 below. The radionuclides of concern (ROCs) are radium-226 (Ra-226) and thorium-232 (Th-232). There are no chemicals of concern.

Table 2 - Radiological Screening Criteria[a]

Radionuclide of Concern	Surface Residual Radioactivity ($dpm/100\ cm^2$)[b]	Soil (or Volumetric) Residual Radioactivity (pCi/g)[c]
Ra-226	100	1.0
Th-232	100	N/A[d]

Notes:

a. Source: Table 3.1, RMP (ITSI Gilbane, 2013).
b. Values are net (i.e., above background) concentrations, in disintegrations per minute per 100 square centimeters ($dpm/100\ cm^2$).
c. Values are concentrations above background, in picocuries per gram (pCi/g).
d No screening criteria have been established at NSTI for Th-232.

The survey data will be statistically compared to background to determine if residual radioactivity levels are indistinguishable from background. Depending on the data collected, sites will be recommended for unrestricted release, further characterization, or remediation. The data collected are anticipated to be sufficient for unrestricted release, assuming that no radiological contamination is found.

Instrument-specific detection sensitivities based on actual field conditions will be used to establish *a priori* minimum detectable concentrations (MDCs) prior to instrument use. The nominal detection sensitivities should be no more than 0.5 times the radiological screening criteria.

1.5 DATA QUALITY OBJECTIVES

The data quality objectives (DQOs) for the radiological survey of Building 3 and impacted wastewater drains are defined in the SAP and summarized in Table 3 (found at end of document).

2.0 SURVEY DESIGN

The outputs from the DQO process and guidance from MARSSIM (DoD, 2000) were used to develop a survey design for data collection. The survey design integrates both probability-based (random and random-start/systematic) and judgmental (biased) data collection methods to achieve the project DQOs. Table 4 lists the survey units and the key design parameters.

Table 4 – Survey Units

Survey Unit Description	Estimated Area (m^2)	Surface Material(s)
Building 3 Optical Shop Roof Area (Class 1 Area)		
Optical shop roof area – north section	100	concrete[a]
Optical shop roof area – center section	100	
Optical shop roof area – south section	100	
Optical shop roof area – buffer area on west side	100	
Optical shop roof area – buffer area on south side	80	
Balance of Building 3 (Class 3 Area)		
Balance of lower roof	5,350	tar, gravel
Main hangar roof	7,750	asphalt shingle
Main hanger area (ground floor)	7,750	concrete
Offices and support areas (ground floor)	5,750	concrete, floor tile
Offices and support areas (other than ground floor)	TBD	TBD
Ground surface perimeter (2-meter width) around building, including roof storm drain outfalls and building entry ways	1,050	asphalt, concrete
Wastewater Drains (Class 1 Area)		
Sanitary sewer pipe (drains and standpipes above grade) that drain northeast corner of the Building 3 roof (5- and 6-inch-diameter pipe)	45[b]	metal, adjacent building materials
Gravity-fed wastewater pipes (below grade) and associated manholes which drain northeast corner of Building 3 to pump station 5 (6- and 8-inch-diameter pipe)	105[b]	clay, concrete, soil
Gravity-fed wastewater pipes (below grade) and associated manholes which drained former (demolished) Buildings 7 and 233 to pump station 6 (5- and 6-inch-diameter pipe)	120[b]	clay, concrete, soil

Notes:

a. roofing material to be removed prior to radiological survey and disposed as investigation-derived waste.

b. linear length, in meters.

TBD – to be determined

2.1 CLASSIFICATION

A primary area of concern at Building 3 is the northeastern corner of the roof where the optical shop was located. The optical shop roof area, including a buffer area around it, is designated a Class 1 area. The balance of Building 3 is designated a Class 3 area. There are no Class 2 areas associated with Building 3. The existing gravity-fed wastewater drain piping running downstream from Building 3 and from the former Buildings 7 and 233 is designated a Class 1 area, as it has been identified as having a reasonable potential for residual radioactivity from historical activities.

2.2 SURVEY UNITS

Building 3 is divided into five Class 1 survey units (optical shop roof area) and six Class 3 survey units (balance of building). Class 1 survey units are limited in size of floor area to approximately 100 m^2. No floor area size restriction is imposed on Class 3 survey units. The survey units consist of the exposed interior surfaces (i.e., floors, lower walls, doorways, and entry/exit points), including access points to floor and roof drains, in areas where activities involving radioactive material may have occurred. The impacted media are the concrete, floor tile, masonry, and plasterboard found on exposed interior building surfaces, primarily the floor and lower walls; and the tar, gravel, and asphalt roofing on the roof.

The impacted wastewater drains are divided into three Class 1 survey units. The impacted media are the clay, concrete, and metal internal surfaces of the drain system components and, in the event a leak occurred, the surrounding soil or building material.

Data analysis will be performed and a separate decision will be made for each survey unit as to its suitability for radiological clearance (see Section 5.0).

2.3 SURFACE SCAN MEASUREMENTS

Scan measurements of Class 1 survey units will be performed over 100 percent of the accessible and suitable surface areas. Scan measurements will be performed over 10 percent (or more) of the surface areas of each Class 3 survey unit. The areas of highest potential for elevated residual radioactivity (e.g., corners, ditches, and drains) will be selected based on professional judgment. This provides a qualitative level of confidence that no areas of elevated residual radioactivity will be missed by the static measurements and that there were no errors made in the classification of the survey unit. If the entire survey unit has an equal probability for areas of elevated residual radioactivity, systematic scans will be performed along transects of the survey unit or of randomly selected grid blocks.

Two types of scan measurements will be performed. The scan measurement methods are described in Section 4.2. A gross gamma scan will be performed of Class 1 areas, including wastewater drain piping whose surfaces may be inaccessible or difficult to measure directly using field survey detectors and established techniques. The gross gamma scan will be performed to locate radiation anomalies (i.e., irregularities) that might indicate areas of volumetric or subsurface residual radioactivity not readily detectable by the beta surface scan, but that warrant further investigation.

An alpha/beta surface scan will be performed of structure surfaces, including accessible wastewater drain piping. The alpha/beta surface scan will be performed to detect small areas of elevated surface residual radioactivity that may not be detected by static measurements using a random-start systematic pattern (Class 1 areas) or a random pattern (Class 3 areas).

2.4 STATIC MEASUREMENTS

Static measurements of alpha- and beta-emitting surface residual radioactivity will be collected from accessible and suitable structure surfaces. The static measurements will provide a quantitative measure of the radioactivity present at the location measured for comparison to the radiological screening criteria. The static measurement method is described in Section 4.2.

2.4.1 Number of Measurements

A minimum of 20static measurements will be collected per survey unit. This number of measurements was developed using the MARSSIM process and is based on the design goals and constraints described in Attachment 1 of the RMP (ITSI Gilbane, 2013).

2.4.2 Measurement Locations

A random-start systematic square grid pattern will be used to identify measurement locations in Class 1 survey units. The starting point will be determined by a random selection process, and successive measurement locations will be distributed around the starting point in a systematic pattern across the survey unit. The physical spacing of the measurement locations, L, was determined as follows (MARSSIM [DoD, 2000], Equation 5-6):

$$L = \sqrt{\frac{A}{n}}$$

where n is the number of measurements (20) and A is the total surface area of the survey unit. The measurement locations will be identified around the starting point at radial intervals of 90 degrees and spaced from each other at a distance of L. This process will be repeated at successive points to identify the pattern of measurement locations throughout the survey unit. For wastewater drain piping, the random-start systematic pattern will applied in a linear fashion.

Measurement locations in Class 3 survey units will be generated using a random number generator or other random selection method. Random means that each measurement location in the survey unit had an equal probability of being selected.

Measurement locations that do not fall within the survey unit area or that cannot be surveyed due to site conditions, including health and safety considerations, will be replaced with other measurement locations determined using the random selection process.

Measurement locations selected on the basis of professional judgment violate the assumption of unbiased measurements used to develop the statistical tests and will not be used in the statistical evaluation.

2.4.3 Location Identification

Measurement locations within each survey unit will be identified clearly and documented to ensure that they can be relocated if necessary. Actual measurement locations will be marked with flags, stakes, notations on survey maps, or equivalent methods. Each measurement location will be identified by a unique identification code or number to allow the survey data to be referenced to specific measurement locations identified on the photographs, drawings, or maps of the survey unit. The measurement numbering scheme to be used is described in the SAP.

2.5 SUPPLEMENTAL SAMPLES

Supplemental samples such as soil, bulk material, and smear samples may be collected for laboratory analysis where residual radioactivity is suspected to be present and additional qualitative information regarding its form and/or isotopic composition is desired. Supplemental sampling methods are described in Section 4.4.

2.6 DATA INVESTIGATION

While measurements above the radiological screening criteria are not necessarily unexpected for a Class 1 survey unit, any scan or static measurement exceeding the radiological screening criteria will be investigated. In addition, areas identified by scan measurements whose readings exceed the mean plus three standard deviations (3σ) of the collected data set will be investigated. Readings above this value indicate a probability greater than 99% that the data point does not belong to the same population as the rest of the data set (i.e., potentially represents contamination rather than background radioactivity) and should be investigated.

2.6.1 Investigation

Locations identified by scan or static measurements with residual radioactivity that exceeds the radiological screening criteria will be marked and investigated. The elevated survey measurement will be confirmed to verify that it actually exceeds the radiological screening criteria. The area around the elevated measurement will be investigated to determine the extent of the elevated residual radioactivity and to provide reasonable assurance that adjacent undiscovered areas of elevated residual radioactivity do not exist.

Static measurements above the radiological screening criteria that should have been identified by scan measurements, but were not, may indicate that the scanning method is inadequate. In that case, the scan method will be evaluated and appropriate corrective actions will be taken and documented. Corrective actions may include rescanning the survey unit.

Depending on the results of the investigation, the survey unit may require remediation, resurvey, or reclassification (Class 3 to Class 1). The Navy will be consulted to provide that direction.

2.6.2 Remediation

Areas of elevated residual radioactivity that exceed the radiological screening criteria will be remediated to reduce elevated residual radioactivity to acceptable levels. Based on the survey data, all or a portion of a survey unit may be remediated. Remediation may include removal of materials such as asphalt applied over soil, concrete, and/or piping; removal of localized hotspots or commodities; soil excavation; and surface decontamination. If soil contamination extends deeper than 15 centimeters (cm) below the drain piping, the Navy will be notified and, following Navy direction, the contamination will be remediated.

Remedial action support surveys will be conducted to assess the effectiveness of remedial action and to guide the remediation in real time. Radiation protection measures, including radioactive material and contamination control, will be instituted as described in the RPP.

2.6.3 Resurvey

If remediation activities are performed, then a resurvey will be performed. Where a small fraction of the area of the survey unit is remediated, a resurvey of only the remediated area will be performed. Scan measurements will be performed over 100 percent of the remediated area. Biased static measurements will be collected in and around the remediated area to ensure the efficacy of the remedial action. Replacement (post-remediation) static measurements will be collected within the remediated area at the same systematic measurement locations.

2.6.4 Reclassification

If survey measurements in a Class 3 survey unit exceed the radiological screening criteria or suggest that there may be a reasonable potential that residual radioactivity is present in excess of the radiological screening criteria, the survey unit will be reclassified as a Class 1 survey unit. A Class 3 survey unit that is remediated will be reclassified as a Class 1 survey unit.

Due to size restrictions and other considerations, a reclassified survey unit may be divided into two or more survey units. The extent of the elevated residual radioactivity (and corresponding remediation) relative to the total area of the original survey unit will be considered.

2.7 BACKGROUND REFERENCE AREA

Representative measurements of background may be collected from one or more reference areas for comparison with scan measurements, static measurements, and/or volumetric samples. If used, reference areas will be selected from non-impacted areas that have radiological, chemical, and physical characteristics similar to the survey unit with which their measurements will be compared. The measurements will be distributed randomly within the reference area, as recommended by MARSSIM (DoD, 2000), Section 5.5.2.5. The same number and type of measurements will be collected in the reference area as in the corresponding survey unit.

2.8 REFERENCE COORDINATE SYSTEM

A reference coordinate system will be used to facilitate the selection of measurement locations and to provide a mechanism for referencing a measurement to a specific location. Scale drawings, maps, or photographs of the survey area will be prepared and oriented according to the reference coordinate system. Where not otherwise specified, the state plane coordinates for the California State Plane Zone 3, North American Datum (NAD) 1927, will be used.

3.0 FIELD IMPLEMENTATION

Field implementation activities will be performed in accordance with the RMP, Section 7.0.

3.1 NOTIFICATIONS

Table 5 summarizes the events for which notifications will be made and the persons and/or agencies to which the notifications will be made.

Table 5 – Notifications

Notification Event	Navy RPM	RASO	ROICC	CSO	CDPH	USA
Mobilization	✓	✓	✓	✓		
License implementation	✓				✓	
Soil excavation	✓					✓
Significant event[a]	✓	✓	✓	✓		
Schedule change	✓	✓	✓	✓		
Demobilization	✓	✓	✓	✓		

Notes:

[a] See definition in the RMP, Section 7.1.2.

Navy RPM – Navy Remedial Project Manager
RASO – Naval Sea Systems Command Detachment, Radiological Affairs Support Office
ROICC – Resident Officer in Charge of Construction (Navy)
CSO – NSTI Caretaker Site Office
CDPH – California Department of Public Health
USA – Underground Service Alert

3.2 BUILDING 3 SURVEYS

Building 3 surveys generally will be performed in a top-down and inside-out manner. Roof areas will be surveyed first, followed by building areas above the ground floor, and then the ground floor areas inside the building. The last survey performed will be of the outside perimeter of Building 3.

The first survey to be performed will be of the roof areas where the optical shop was located. A gross gamma surface scan will initially be performed. The roofing material will be removed and stockpiled in such a manner that its location on the roof can be determined. An alpha/beta surface scan then will be performed, followed by the collection of static measurements in accordance with the survey design. Locations with readings above the radiological screening criteria will be investigated (see Section 2.6).

The removed roofing material will be treated as investigation-derived waste (IDW) and segregated as either low-level radioactive waste (LLRW) or non-LLRW. Where residual radioactivity above the radiological screening criteria is detected in the roofing material itself or on the surface beneath it, the material will be deemed LLRW and turned over to the Navy's waste contractor for disposal as such. The Building 3 roof will be returned to its pre-survey condition.

3.3 IMPACTED WASTEWATER DRAIN SURVEYS

Wastewater drain surveys generally will be performed in a top-down, upstream-downstream manner. The Building 3 above-grade drains and standpipes will be surveyed before the below-grade drain piping. Surveys will be performed starting at the upstream end of the wastewater drain piping and working toward the downstream terminus. If not already present, an opening will be created by excavation to verify that piping is present and can be followed from the point of origin. In the event that no line features are present, excavator potholing may be used to verify the presence or absence of drain piping.

As a general rule, access to internal surfaces will be created (i.e., the soil will be excavated and the piping cut or broken into) approximately every 15 m to facilitate data collection. Alpha/beta static measurements will be taken at these points. A visual inspection of the pipe internals will be performed by running a camera through the pipe to identify sediment, debris, and cracked or broken piping where leakage may have occurred. Gross gamma surface scan measurements will be taken between access points by pushing or pulling the detector through the piping in a controlled manner. Inaccessible or difficult-to-measure internal surfaces will be assumed to have the same level of residual radioactivity as that found on accessible internal surfaces. Scale and sediment samples of residual material will be collected. Soil samples will be collected adjacent to and/or beneath drain piping at random locations and, if evident, where cracked or broken piping may have leaked. Localized excavation (e.g., pot holing), direct push (e.g., Geoprobe), directional soil boring, or similar methods will be used to minimize the extent of soil disturbance.

A combination of visual inspection, gross gamma surface scan measurements, alpha/beta static measurements at accessible locations, samples of residual material inside the pipe, and samples of soil adjacent to and/or beneath the pipe at points of possible leakage will be used to determine the radiological condition of the drain piping and the surrounding soil.

Loose material generated during excavation will remain at the point of excavation and returned to the hole once the survey is complete. In the event that water accumulates in an excavation cavity and/or impedes survey activities, it will be managed in a manner similar to decontamination water and stormwater runoff. Removed water will be pumped into a holding tank. It will be filtered, sampled, and analyzed to verify compliance with the radiological screening criteria prior to discharge.

4.0 DATA COLLECTION

Survey data will be collected by trained individuals using calibrated instruments as prescribed by Section 4.2 and Section 8.1 of the RMP (ITSI Gilbane, 2013).

4.1 INSTRUMENTATION AND METHODS

Survey measurements will be performed using the instrumentation and methods described below. Typical survey instrumentation is shown in Table 6. Where the indicated instrumentation is unavailable or is unsuitable to field conditions, an equivalent instrument will be used. Changes made to the survey methods, including any field adjustments made to surface-to-detector distance, scan rate, or count time, will be documented.

Table 6 - Typical Survey Instrumentation

Measurement Type	Detector Type	Effective Detector Area and Window Density	Instrument Model	Detector Model
Gross Gamma Scan	NaI(Tl) scintillation	5.1 cm diameter/length (2x2-inch) N/A	Ludlum 2221	Ludlum 44-10
Alpha/Beta Scan/Static	Gas flow proportional	584 cm^2 3.4 mg/cm^2 aluminized Mylar	Ludlum 2360	Ludlum 43-37
	Dual phosphor scintillation	100 cm^2 1.2 mg/cm^2 aluminized Mylar	Ludlum 2360	Ludlum 43-93
Alpha/Beta Smears	Gas flow proportional	5.1 cm diameter 0.08 mg/cm^2	Protean WPC-9550	N/A
	Dual phosphor scintillation	5.1 cm diameter 0.4 mg/cm^2	Ludlum 2929	Ludlum 43-10-1

Notes:
cm^2 – square centimeter
cm – centimeter
mg/cm^2 – milligrams per square centimeter
NaI(Tl) – sodium iodide (thallium activated)
N/A – not applicable

Nominal detection sensitivities of typical survey instrumentation are shown in Table 7. The results shown are based on representative count times, background counts, and instrument efficiencies. Instrument-specific values based on actual field conditions will be used to establish *a priori* MDC values before an instrument is used, to ensure that the instrument is capable of detecting radiation at or below the radiological screening criteria.

Table 7 - Typical Detection Sensitivities

Detector Model	Radiation of Interest	Count Time (min)	Back-ground (cpm)	Total Efficiency[a] (cpm/dpm)	Scan MDC[b] (dpm/100 cm^2)	Static MDC[c] (dpm/100 cm^2)
Ludlum 43-37	Alpha	2	10	0.09	N/A	23
Ludlum 43-37	Beta	2	600	0.15	390[d]	67
Ludlum 43-93	Alpha	2	1	0.19	N/A	25
Ludlum 43-93	Beta	2	140	0.12	N/A	340
Protean WPC-9550	Alpha	1	0.05	0.42[e]	N/A	10
Protean WPC-9550	Beta	1	0.4	0.43[e]	N/A	14
Ludlum 43-10-1	Alpha	1	0.6	0.35[e]	N/A	19
Ludlum 43-10-1	Beta	1	40	0.16[e]	N/A	200
Ludlum 44-10	Gamma	N/A	160	N/A	2.8 pCi/g[f]	N/A

Notes:

a. Total efficiency equals instrument efficiency multiplied by surface efficiency.
b. Scan MDC is calculated per *MARSSIM* (DoD, 2000) Equation 6-10 and assumes a surveyor efficiency of 0.5, and a value of 1.38 for acceptable false indications.
c. Static MDC is calculated per *MARSSIM* (DoD, 2000) Equation 6-7.
d. Scan MDC assumes an observation interval of 1 second, which results from a scan speed of 15 cm (approximately one detector width) per second.
e. 4π detection efficiency assumed
f. Scan MDC is based on detection of Ra-226 and is calculated using the approach described in Section 6.8.2 of NUREG-1507, *Minimum Detectable Concentrations with Typical Radiation Survey Instruments for Various Contaminants and Field Conditions* (United States Nuclear Regulatory Commission [NRC], 1998a).

min – minute
cpm – counts per minute
dpm – disintegrations per minute
cm^2 – square centimeter(s)

4.2 SCAN MEASUREMENTS

The two types of scan measurements to be performed are gross gamma surface scans and alpha/beta surface scans.

4.2.1 Gross Gamma Surface Scan

Gross gamma scans will be performed using a Ludlum Model 44-10 2-inch by 2-inch (5.1 cm) sodium iodide (thallium-activated) (NaI(Tl)) gamma scintillation detector with a Ludlum 2221 rate meter/scaler. For scans of structure surfaces, the detector will be maintained at a height of approximately 0.1 m above the ground and moved over the surface at a speed of 0.5 meters per second (m/s), with each pass spaced 0.5 m (or less based on detector field of view) from the previous pass to achieve 100 percent coverage of the area being surveyed. For scans inside drain piping, the detector will be moved through the piping at a speed of 0.5 m/s or less. No attempt will be made to orient the detector relative to the inside of the pipe. Moving the detector through the pipe along the bottom, where residual radioactivity is more likely to accumulate, will conservatively bias the scan results high. Changes to scan height and speed may be made to optimize detection response while accommodating field conditions.

4.2.2 Alpha/Beta Surface Scan

The alpha/beta surface scan will be performed using a Ludlum Model 43-37 584-square-centimeter (cm^2) large-area gas-flow proportional detector with a Ludlum Model 2360 alpha/beta data logger. Scan measurements will be performed by moving the detector approximately 1 cm above the surface of interest at a scan rate of 15 centimeters per second (cm/s). For alpha scan purposes, a count time interval will be calculated in accordance with Attachment 3 of the RMP (ITSI, 2013). The audible indication of the data logger will be used to alert the surveyor to stop scanning whenever an alpha count is registered. The surveyor will pause at the location where the alpha count was registered for the required time interval to allow the detector to register one or more additional counts that may represent residual radioactivity. The scan rate may be adjusted depending on the expected detector response.The Ludlum Model 43-93 100-cm^2 zinc sulfide (silver activated) (ZnS(Ag)) dual phosphor scintillation detector with a Ludlum Model 2360 alpha/beta data logger will be used for surface scan measurements of small areas.

4.3 STATIC MEASUREMENTS

Static measurements of alpha/beta surface residual radioactivity will be performed using a Ludlum Model 43-37 584-cm^2 large-area gas-flow proportional detector with a Ludlum Model 2360 alpha/beta data logger, or a Ludlum Model 43-93 100-cm^2 ZnS(Ag) dual phosphor scintillation detector with a Ludlum Model 2360 alpha/beta data logger. Surface measurements will be performed by placing the detector on the surface to be measured, taking a two-minute (or longer) scaler count, and recording the reading.

4.4 SUPPLEMENTAL SAMPLING METHODS

The two types of supplemental samples that will be collected are bulk material and smear samples. Each sample will be labeled and assigned a unique sample identification number. The sample identification number, sample location, date and time of sample collection and the name of the sample collector will be recorded. The sample numbering scheme to be used is described in the SAP.

4.4.1 Soil and Bulk Material Samples

Samples of soil and bulk material such as asphalt, concrete, or other material will be representative of the sampled media and will be of sufficient size to allow laboratory analysis to achieve the desired detection level. Methods appropriate to the type of material being sampled (e.g., scraping chipping, boring, etc.) will be used to collect the sample. Suitable controls will be used to prevent cross-contamination of the sample media. Sampling equipment (e.g., hand and power tools, mixing utensils, and homogenizing bowls) will be decontaminated (using dry methods) between samples.

As a general rule, approximately 1,000 grams of material, if available, will be collected per sample. A smaller sample volume may suffice depending on the laboratory analysis to be performed. Visually identifiable foreign objects and debris will be separated manually in the field. Bulk material samples will be size-reduced in the field to the extent possible.

Samples will be double bagged in one-gallon resealable plastic bags, numbered, logged, and sent for laboratory analysis. Samples will be stored in a secure facility or will remain under positive control of the person collecting the sample until it is time to transfer custody or ship the samples. When custody is transferred (e.g., when samples are sent for laboratory analysis), a chain-of-custody (CoC) record will accompany the samples for tracking purposes. Any special handling requirements identified in the field will be communicated to the laboratory performing the analysis using the sample CoC record. The samples will be packed properly to ensure their safe arrival at the analytical laboratory.

Samples will be analyzed in accordance with the project DQOs. Samples will be prepared by drying, grinding, mixing, sifting, and weighing as appropriate prior to analysis. The samples will be prepared and analyzed in accordance with the laboratory's approved procedures.

Samples will be analyzed by gamma spectroscopy for Ra-226 (using the in-growth method). Additional analyses to detect and quantify fission, transuranic, and source material, including any tests specifically required for waste management, will be performed based on the results of the above analysis and/or discussions with the Navy's waste contractor.

4.4.2 Smear Samples

Smear samples will be collected over approximately 100 cm^2 and analyzed for alpha and beta radioactivity using a Protean WPC-9550 gas-flow proportional alpha/beta counting system (or equivalent), using a count time of one minute or longer to meet the required MDC. Field counting of samples may be performed using a Ludlum Model 43-10-1 ZnS(Ag) dual phosphor alpha/beta scintillation detector with a Ludlum Model 2929 alpha/beta scaler.

5.0 DATA EVALUATION

The survey data collected according to project DQOs will be both quantitative and qualitative in nature. Data will be analyzed quantitatively for direct comparison to the radiological screening criteria and reviewed qualitatively to determine whether further investigation is appropriate. Static measurements will be used as quantitative inputs. Scan measurements, bulk material samples, and smear samples will be used as qualitative inputs. While those measurements and samples will provide quantitative results, those results will be used in a qualitative manner as there are no quantitative criteria with which to meaningfully compare them. Where analytical laboratory and field measurement results disagree, the analytical laboratory results will be used to support the decision.

5.1 DATA VALIDATION AND VERIFICATION

Survey data will be reviewed to verify that they are authentic, appropriately documented, and technically defensible. The review criteria for data acceptability are as follows:

- The instruments used to collect the data were capable of detecting the radiation types and energies of interest at or below the radiological screening criteria.
- The calibration of the instruments used to collect the data was current, and the radioactive sources used for calibration were traceable to the National Institute of Standards and Technology.
- Instrument response was checked before and, where required, after instrument use each day data were collected.
- The MDCs and the assumptions used to develop them were appropriate for the instruments and the survey methods used to collect the data.
- The survey methods used to collect the data were appropriate for the media and types of radiation being measured.
- The custody of samples collected for laboratory analysis was tracked from the point of collection until final results were obtained.

Where one or more of the criteria are not met, the discrepancy will be reviewed, and the reasons for acceptability of the data or the corrective actions taken to restore data acceptability will be documented.

5.2 DATA ANALYSIS

Survey data will be analyzed to identify distribution trends and potential outliers. Data analysis will include visual inspection of measurement results using posting plots, cumulative frequency distributions, histograms, etc., as required, and calculation of statistical quantities including mean, median, standard deviation, and range. Data analysis of survey results for each survey unit will be performed in the field, as necessary, to evaluate whether an investigation or additional survey data collection is warranted. Data analysis will include investigation of spatial or temporal distribution, outliers, and data population distributions.

5.3 DATA INTERPRETATION

The results of the data analysis will allow one of two conclusions to be drawn. The first conclusion is that the survey data are sufficient to recommend radiological clearance for unrestricted use. The second conclusion is that the survey data are not sufficient to recommend radiological clearance for unrestricted use and further characterization and /or remediation is warranted. Where the survey data are found to represent residual radioactivity statistically distinguishable from background, an assessment of incremental dose to future land users will be prepared.

6.0 DATA REPORTING

Data will be reported to the Navy on a daily basis as it is generated and summarized in a report at the completion of work activities.

6.1 DAILY FIELD REPORTING

Data will be compiled and submitted to the Navy as it is generated in the field to document that field work is being completed as expected. Daily radiological and field reports will be completed throughout the time of the field work performance. The daily reports will include:

- A description of work completed;
- Any deviations from project plans and the reason for these changes;
- The work that is planned to be accomplished during the week of the report;
- Any complications that are identified in the field, how the complications will be resolved, and if they will affect the schedule; and
- A summary of the data that was collected the previous day.

The reports will be submitted electronically to the Navy.

6.2 SURVEY REPORT

A survey report will be prepared to summarize the work performed. Survey data will be reported along with conclusions and recommendations. The results of the analysis and interpretation of survey data will be summarized, and conclusions regarding the radiological status of Building 3 and the impacted wastewater drains will be documented.

Specifically, the report will include:

- A description of the field work and the results of analysis.
- A preliminary screening evaluation of the analytical results collected during the field work.
- Discussion of the results, including interpretation of survey results, an assessment of the data (and whether the data meet the project DQOs), descriptions of data uncertainties, and other information required to support the conclusions and recommendations offered.
- Conclusions and recommendations based on the technical evaluation of the data collected.

A technical summary will be prepared that summarizes the results of the analysis and interpretation of the FSS data, and conclusions regarding the radiological status. The summary will address California Code of Regulations, Title 17, Section 30256(k), which, when satisfied, authorizes CDPH concurrence for release for unrestricted use. The summary will be designed such that it can be used as an attachment to the Navy's request to CDPH for such concurrence.

7.0 REFERENCES

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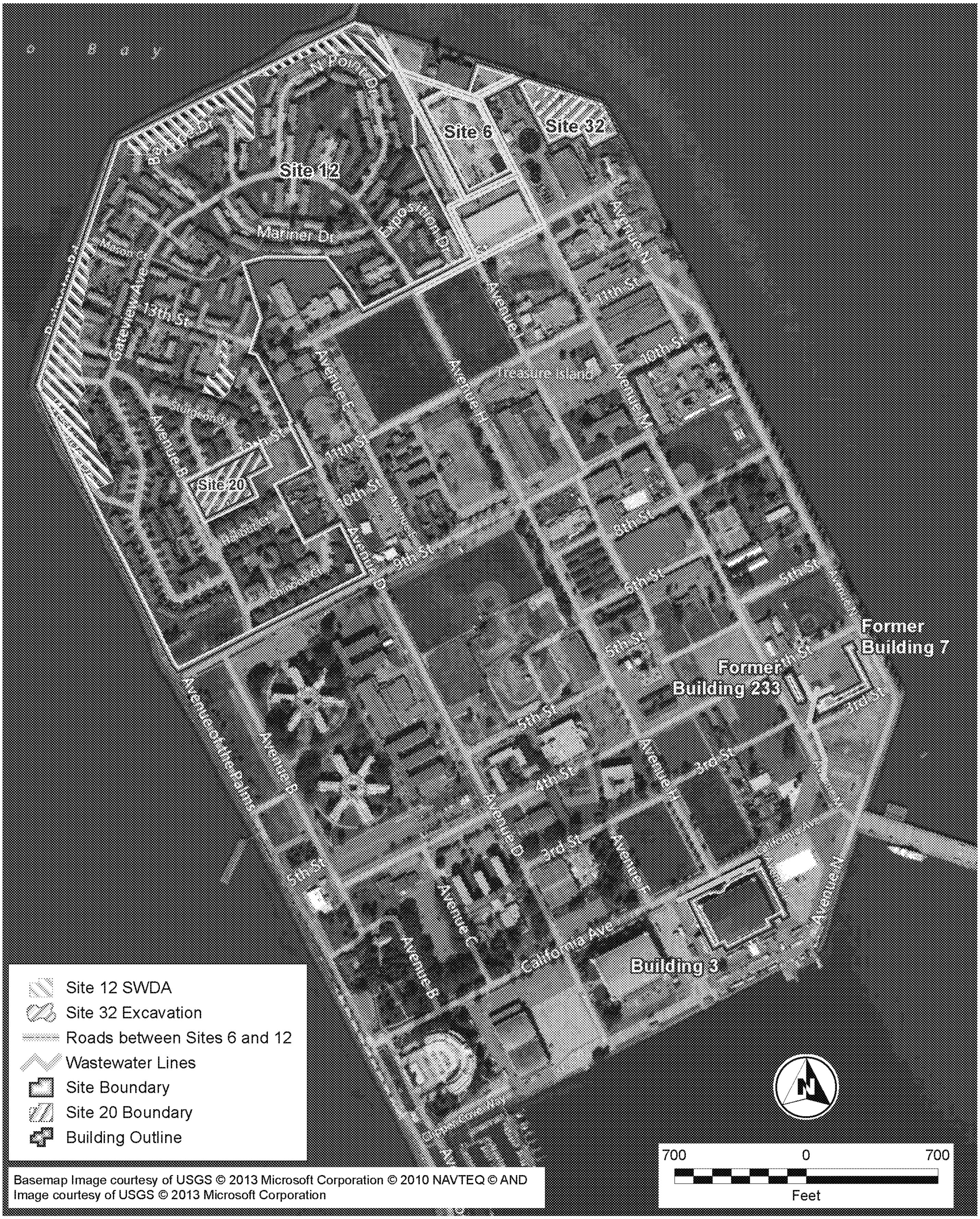
FIGURES



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ITSI Gilbane

Radiological Scoping Surveys
Department of the Navy
Naval Station Treasure Island
San Francisco, California

FIGURE 1
NSTI Site Layout Map

TABLES

Table 3 – Summary of Data Quality Objectives

STEP 1 **Statement of Problem**	**STEP 2** **Decisions**	**STEP 3** **Inputs to the Decisions**	**STEP 4** **Boundaries of the Study**	**STEP 5** **Decision Rules**	**STEP 6** **Limits on Decision Errors**	**STEP 7** **Optimizing the Sampling Design**
The Navy would like to clear the following radiologically for unrestricted use: Building 3 and existing gravity-fed wastewater pipes that extend from Building 3, and from beneath the footprint of the former Buildings 7 and 233, and continue to downstream pumping stations. Radiological data are needed to determine if residual radioactivity requiring remediation is present. If remediation is required, the Navy will be consulted. If no remediation is required, the data will provide a suitable technical basis for clearing the building and wastewater collection system radiologically for unrestricted use.	The principal study question is: "Is residual radioactivity requiring remediation present in Building 3 and in the impacted wastewater drains?" Total and removable surface contamination measurements will be used to answer the question quantitatively. The following alternative actions will result from resolution of the principal study question: • If the levels of residual radioactivity meet the radiological screening criteria, then the building and drains are suitable to clear radiologically for unrestricted use. • If the levels of residual radioactivity do not meet the radiological screening criteria, then the building and drains are not suitable to clear radiologically for unrestricted use. Based on the principal study question and the alternative actions listed above, the decision statement is: "Determine whether or not the levels of residual radioactivity meet the radiological screening criteria." The decision is formulated into statistical hypotheses. The state that is presumed to exist in reality is expressed as the null hypothesis (denoted by H_o): • H_o: The levels of residual radioactivity do not meet the radiological screening criteria. For the given null hypothesis, the alternative hypothesis (denoted as H_a), which is an expression of what is believed to be the state of reality if the null hypothesis is not true, is: • H_a: The levels of residual radioactivity meet the radiological screening criteria. As the null and alternative hypotheses are applied here, Building 3 and the impacted wastewater drains will not be considered suitable to clear radiologically for unrestricted use unless the survey data show that the levels of residual radioactivity meet the radiological screening criteria.	The ROCs are Ra-226 and Th-232. There are no chemicals of concern. The impacted media are building materials found on exposed interior building surfaces, primarily the floor and lower walls; the former location of the optics shop (northeastern corner of roof) and the sanitary sewer pipe that leaves the area; and wastewater pipes that drained the northeastern corner of Building 3 and the former Buildings 7 and 233. For surfaces, beta surface scan measurements and alpha/beta static measurements will be used as quantitative inputs. Samples of removable surface residual radioactivity (smears) analyzed for gross alpha/beta radioactivity may be used as qualitative inputs. For volumes, volumetric samples analyzed by gamma and/or alpha spectroscopy will be used as quantitative inputs. Gross gamma scan measurements may be used as qualitative inputs. Measurements above the radiological screening criteria will trigger further evaluation of identified areas of elevated residual radioactivity.	The target population is surface and volumetric residual radioactivity concentrations of the ROCs on and/or in the impacted media. The spatial boundaries are the exposed interior surfaces (i.e., floors, lower walls, doorways, entry/exit points), including access points to floor and roof drains, in areas where activities involving radioactive material may have occurred, and from internal surfaces of gravity-fed wastewater pipes. These surfaces constitute impacted areas, which are considered to have been susceptible to radioactive contamination from building activities. Decisions will be made on three fundamental scales: • Localized areas:-The decision to collect additional data will be made for discrete areas with measurement results that exceed the radiological screening criteria. • Survey unit: Building 3 and the impacted wastewater drains will be divided into survey units based on similar physical characteristics and potential for residual radioactivity. A decision will be made for each survey area as to its suitability for radiological clearance or, alternatively, its need for remediation and/or additional data collection. • Entire building or wastewater collection drain: Survey data will be evaluated on a building or wastewater drain-wide basis and used to support decisions made by the primary decision maker regarding suitability for radiological clearance.	The following decision rules will be used to collect data. Parameter of Interest: Scan Measurements Perform scan measurements (gross gamma or beta) over 100% (Class 1) or 10% (Class 3) of surface area. **IF** areas identified with measured radioactivity above mean + 3σ … **THEN** investigate to determine area of elevated residual radioactivity, remediate, and resurvey; **ELSE** collect static measurements. Parameter of Interest: Static Measurements Collect static measurements (alpha/beta surface measurements) from random-start, systematic (Class 1) or random (Class 3) locations. **IF** static measurements exceed radiological screening criteria… **THEN** investigate to determine area of elevated residual radioactivity, remediate if appropriate, and resurvey Parameter of Interest: Statistical Test Perform statistical test if one or more static measurements exceed the radiological screening criteria. **IF** null hypothesis rejected … **THEN** conclude survey unit is acceptable to be radiologically cleared for unrestricted use; **ELSE** investigate failure, remediate, and resurvey.	To ensure data quality, data will be reviewed, verified, and validated in accordance with the SAP. To ensure usability of laboratory data, appropriate laboratory methods have been selected to provide the necessary laboratory detection limits. The two principal decision errors, based on the principal study question, are: • deciding the levels of residual radioactivity meet the radiological screening criteria when, in fact, they do not (referred to as a false negative or Type I decision error); and • deciding the levels of residual radioactivity do not meet the radiological screening criteria when, in fact, they do (referred to as a false positive or Type II decision error). Neither type of decision error is desirable. A Type I decision error is defined as the probability of passing a survey unit that should fail. The consequence of a Type I decision error is that material with elevated residual radioactivity is not remediated properly. A Type II decision error is defined as the probability of failing a survey unit that should pass. The consequences of a Type II decision error are the collection of additional data and/or unnecessary remediation. A decision error rate of 0.05 (5%) will be applied for both Type I and Type II errors for the statistical test. Decision error rates associated with the calculation of instrument MDCs and the number of static measurements also will be set at 0.05 (5%).	A resource-effective design for collecting data sufficient to fulfill study objectives developed in Steps 1 through 6 of the DQO process is described in SAP.